

ENGINEERING
TOMORROW



Danfoss Solutions for Chillers

Better chillers – from the **inside** out

Strict regulations, a competitive marketplace, and the need to optimize system costs compel you to update your chiller designs. Building chillers with Danfoss products and solutions enables you to optimize energy efficiency, reduce development time, and obtain reliable performance for multiple chiller platform types and uses.

Smart technology
in up to

70%

of the chiller value
reduces development
costs



chillers.danfoss.com

Meet the Future Head-on, with Danfoss at your side

Climate change regulations, new demands for energy efficiency, higher expectation of comfort levels, and pressure to reduce overall cost of ownership drive current development in a competitive HVAC marketplace. With Danfoss, you have a business partner who understands the complexity of your business and supports you with the most in-depth expertise of solutions for chiller systems.



Combat Climate Change

Synthetic refrigerants like HCFCs and HFCs have a high global warming potential (GWP).

By using climate-friendly Danfoss components that utilize the R513A, R32, and R452B low-GWP refrigerant and the ultra-low GWP refrigerant R1234ze, you contribute to global efforts to make our planet cleaner.

GWP<7

with chillers featuring Danfoss technologies using R1234ze



Maximize Energy Efficiency

The building sector represents about 40% of global energy use in regions like Europe and the USA and heating and comfort cooling a large part of it. To reduce the global warming impact and lower operating costs, you need new technologies that can maximize energy efficiency. Our technologies for chillers help you meet new regulations and achieve the best energy efficiency with your products.

Up to 40%

lower energy consumption in chillers



Promote Dependable Infrastructure

As the global population continues to grow, energy use is expected to rise by one third by 2035. The introduction of variable speed technology in air conditioning and heat pump systems presents an opportunity for significant reduction of inrush current and can smartly modulate the electric load to the exact need to limit peaks of demand.

70% lower

start current with Danfoss variable speed technology enhances grid reliability



Help Meet Increasing Global Food Demand

An estimated global population of 10 billion people in 2035 means that food needs to be delivered more safely and efficiently. Process chillers provide the support farmers need to grow a greater variety of vegetables in larger quantities, and help them adapt to the different stages of farming to increase quality and turnover.

+/- 0.3°C

temperature and humidity setting guarantees a safe growing and storage process

A global overview of regulations

impacting HVAC markets

60-80%

of current air conditioning systems will not comply with the new standards and need to be redesigned⁽³⁾

USA

Legislation:

ASHRAE 90.1 for rooftops and chillers / DOE for rooftops

Building codes:

ENERGY STAR, Green Building Index, Net Zero Building, ENERGY 2030

Europe

Legislation:

Regulation 517/2014 (F-Gas) Regulation 813/2013 / EcoDesign ENER Lots 1 and 21

Central & South America

Middle East

Saudi Arabia: 2663:2014

Energy Labeling and Minimum Energy Performance Requirements for Air Conditioner

Kuwait: MEW/R-6/2017

Bahrain: Based on SASO regulation

UAE: UAE 5010-5:2014

China

Legislation:

GB 19576 for Unitary A/C GB19577 for Chillers

Asia & Oceania

Building codes:

Greenmark, Green Building Index, Net Zero Building, LEED

A revolution in the A/C market ...

Driven by the global need to reduce CO₂ emissions, new legislation around the world is requiring air conditioning systems with higher energy performance as well as non-ODP (Ozone Depletion Potential) and lower GWP (Global Warming Potential) refrigerants.

In addition to conforming to strict new standards, next-generation systems need to meet the challenges of **complex applications**, increased **energy efficiency**, and **varied climates**, while also providing **flexibility** and a high level of **comfort and reliability**.

Increasing population, rising expectations of comfort, and a high penetration of IT technologies are putting pressure on electric grids, and driving up overall energy consumption and utility peak loads. In parallel, as building designs and functionalities evolve, chiller systems must adapt to meet these new demands. Examples include modern office architecture with large windows, as well as new development or renovation of hospitals, hotels, museums or data centers, where air conditioning is critical.

... opens up new opportunities

As it stands, 60-80% of current air conditioning systems will not comply with the new standards and need to be redesigned⁽³⁾. Original Equipment Manufacturers are increasingly being challenged to provide integrated solutions with superior reliability and efficiency that are easy to install and maintain. Danfoss innovations and technical expertise **support you to build better chillers** from the inside out and take up the challenge of improving part-load efficiency and maintaining full-load performance while **keeping development time** and resulting costs at **competitive levels**.

⁽³⁾ Source Danfoss – Simulation based on Eurovent database and European draft for Ecodesign ENTR LOT 21 Tier2 level.

A chiller for every situation

Energy consumption is a key driver for building owners when it comes to chillers. Depending on the building size, type, and use, as well as the surrounding climate, you need different options for your chiller designs to provide the most value to your customers and differentiate yourselves in the market. We have solutions for chiller needs in a multitude of contexts, from mid-size office buildings that are in operation 10 hours per day, 5 days a week, to data centers and large hospitals that operate 24 hours per day, all year long.

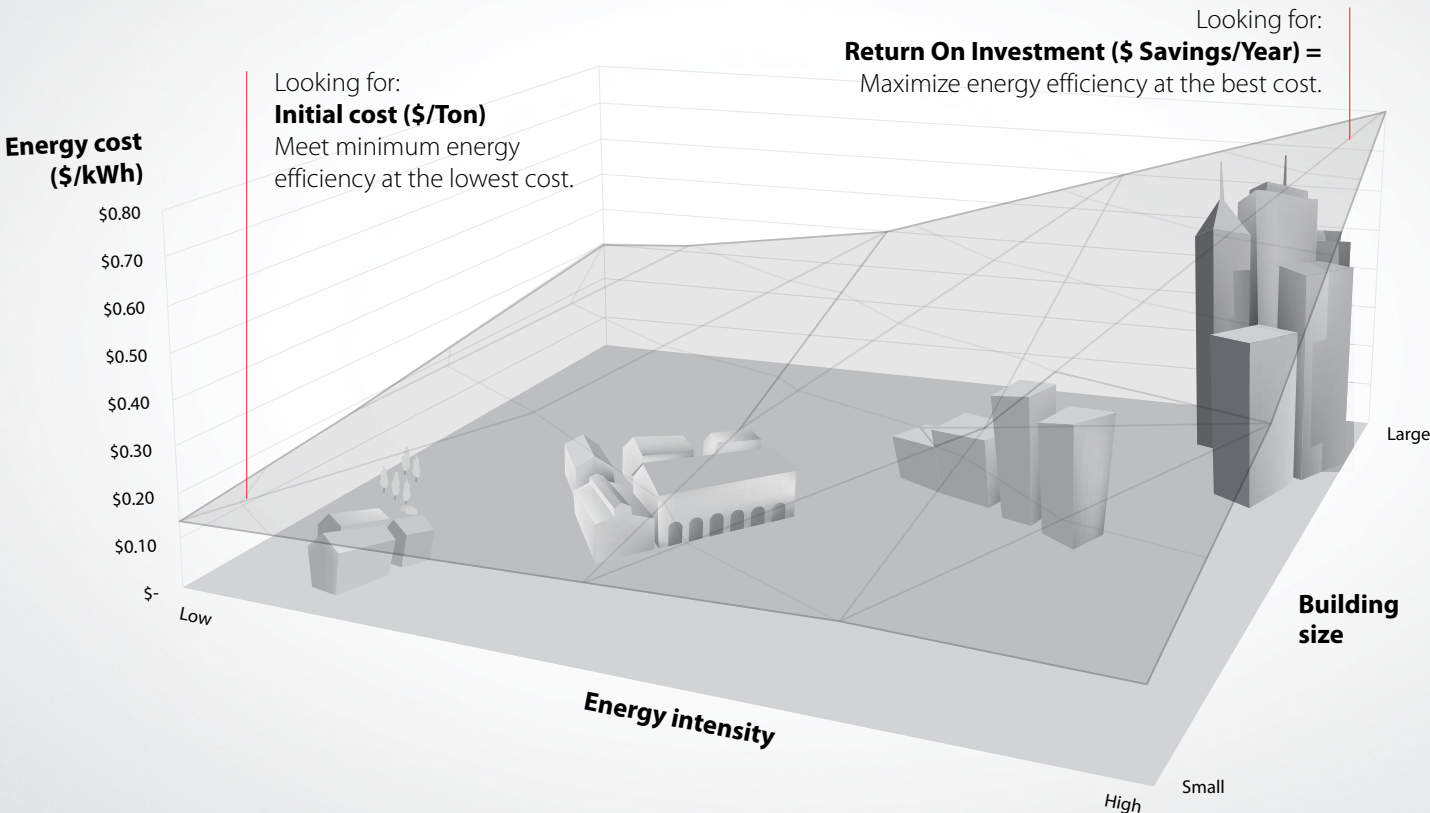
Regardless of the building your chiller system is designed to fit, Danfoss has the widest portfolio of products and technology options to help it perform reliably and efficiently.



Our solutions match the needs of the building owners

3 key drivers for chillers:

- Building Size
- Energy Intensity and number of operating hours over the year
- Energy Cost



Next-generation technology for your next generation of chillers

Danfoss technology helps you keep up with shifting global regulations and stay competitive with low lifecycle costs. Here's how:



Redesign at minimal cost

By using Danfoss scroll compressors with IDV technology, either fixed-capacity or inverter-driven, in combination with our innovative electric expansion valves and heat exchangers, you will be able to offer a chiller system meeting the latest energy requirements with minimal redesign costs.



Go oil-free for maximum efficiency

Oil-free turbo chillers have been proven to deliver the best efficiencies in demanding applications. They also deliver additional benefits for both building owners and end users, which include low maintenance costs, a space-efficient design, and minimal noise levels. After pioneering the oil-free technology with our Turbocor® compressor, Danfoss now offers a wide portfolio of components that which been tested and approved for use in oil-free systems and strengthens reliability of oil-free chillers.

Extensive portfolio of products
tested and qualified
for oil-free systems

Building a **higher standard** for **energy efficiency**

Smart technology
in up to

70%
of the chiller
configuration to
maximize efficiency

Electronic Controls

AB-QM™ pressure independent control valves have a **3-year payback** on complete building installation

Energy Savings

Micro Plate Heat Exchangers deliver a hold up volume of 35% less

Part-load Efficiency

Intermediate Discharge Valves (IDV) inside the scroll and variable speed fans **improve efficiency**, and built-in technology adapts to varying pressure ratios and **delivers higher part-load efficiency (up to 14%)**

Energy Savings

Variable frequency drives can deliver up to **30% energy savings**

Electronic Controls

Electronic controls match varying needs of automation

Part-load Efficiency

Inverter drives **optimize condensing temperatures** for maximum part-load efficiency

Water pumping Energy

Pressure independent balancing valves save water pumping energy and improve chiller part-load conditions

AB-QM pressure independent control valves could lead to HVAC energy **consumption savings of 20-50%**

Energy Savings

Turbocor® magnetic bearing compressor technology uses no oil and enables **energy savings of up to 50%**

Chillers and low-GWP Refrigerants

One of the most important changes currently facing the HVACR industry is how to lower GWP values while also increasing energy efficiency of chiller systems.

Regulation changes require equipment and component manufacturers to rethink traditional design options and find the right balance between affordability, safety and environment. Danfoss is actively working on solutions for alternative refrigerants with a pragmatic approach keeping system applied and running costs in mind.

Chiller designers will focus on using components that allow for the lowest possible charge and on technologies with the best cost/performance ratio for a given refrigerant type.

Choosing a refrigerant is no simple task; it depends on the timing of regional regulations as well as applied standards and building codes. In the last year, the situation has been further complicated by massive price increases and the decreased availability of fluorinated refrigerants.

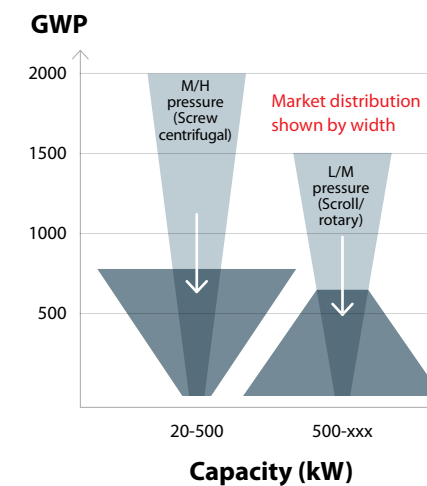
Depending on their size and the compressor technology they use, chillers operate with low to high pressure refrigerants and are divided into two categories: low/medium (L/M) and medium/high (M/H) pressure.

L/M chillers transitioning from R123 can stay non-flammable using HFO solutions like R1233zd (fig.1). R134a applications have non-flammable, A1 solutions with GWP less than 640, such as HFO blends R513A and R450A. If A2L classification is accepted according to applied safety standards and building codes, then the GWP level can come very close to zero using the pure HFO R1234ze (fig.1). We expect industry professionals will adopt this ultra-low GWP refrigerant as a long-term solution for these kinds of systems.

For M/H pressure chillers, there is no ideal non-flammable alternative for incumbent refrigerants such as R410A. Instead, industry professionals must accept A2L or even A3 solutions like R290. A2L alternatives are in the 125-750 GWP range like R32 and several R32/HFO based blends. Their use

should be acceptable for systems installed outdoors or in machine rooms, but their placement must always follow local safety standards and building codes. We foresee that the high density/ pressure refrigerant choice will fall into two groups: the majority with a GWP around 500-750 and a smaller but still significant group applying A3 refrigerants like R290.

GWP level per Chiller size and market development



Main refrigerants in play

| GWP | | A/C & ref | | Ref | | A/C | |
|---------|--------------------------------------|---------------------------------|------------------|-----------------------------------|---|--|--|
| > 4,000 | | | | ○ R404A | | | |
| < 2,500 | | | | ○ R452A ○ R22 ○ R407A/R407F | ○ R410A | Flammability line | |
| < 1,500 | | ○ R134a | | ○ R449A ○ R448A | | | |
| < 700 | | ○ R450A ○ R513A ○ R515 | | ○ R454A ○ R444B | ○ R32 ○ R454B ○ R452B | | |
| < 150 | ○ R1233zd ○ R514A ○ R12336mzzz | ● R1270 ● R600a ● R1234ze | | ○ R454C ○ R455A ● R290 | No LGWP option. Must move to low density | ○ R744/CO ₂ ● R717/NH ₃ | |
| | R123 like | R134a like | R404A R22 like | R410A alike | Others | | |

Density →

Legend

- A1 - Non-flammable
- A2L - Mildly flammable
- A3 - Highly flammable
- B2L - Toxic less flammable
- Old reference refrigerant
- New and on the market
- Not yet on the market

Figure 1: Carbon Chain Based Refrigerants (HCs, HFCs, HCFCs), GWP versus Density (pressure) of the main refrigerant groups

Your source for chiller solutions

With up to 70 % of products for chillers in our portfolio, we offer a powerful combination of expertise and product options that will enhance your chiller designs, and increase your bottom line.



Compressors

Danfoss compressor technologies and models are designed to fit a large selection of chiller systems and cooling capacities. You can choose among Danfoss scroll compressors with or without IDVs, Danfoss inverter scrolls, or Danfoss Turbocor® compressors – each one helps you maximize the efficiency of your designs and gives you flexibility to redesign and upgrade as you see fit.

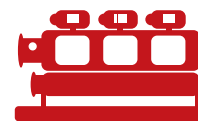
Danfoss compressors range from 3 to 400TR and offer the widest technology options to address new regulations.



AC Drives

Danfoss AC Drives work in combination with chiller compressors, condenser/evaporator fans and water pumps to adapt capacity to actual demand. Variable Speed control enables tremendous energy savings and minimizes Total Cost of Ownership by reducing wear and tear as well as maintenance costs on components and systems.

Danfoss Extensive portfolio of AC Drives dedicated for chiller compressors, fans and pumps incl. low harmonic AFE drives and medium voltage drives ranges from 0.55kW to 7MW



Heat Exchangers

Maximizing the heat transfer in your condenser or evaporator is critical to achieving the highest efficiency possible within your chiller system. We are continuously expanding the range of our heat exchangers and also offer economizers with built-in controls to increase the capacity and energy efficiency of your chillers.

The technology in our Micro Channel and Micro Plate Heat Exchangers helps to make a difference in terms of energy consumption and refrigerant charge.



Electronics and sensors

Danfoss has an extensive range of electronic controls and sensors developed to monitor and optimize the operation of your chiller systems.

Solutions range from a basic valve driver to a complete system controller capable of monitoring and controlling fans, pumps, valves and compressors as needed. Danfoss electronic systems put the power of our components directly in your hands.

Use the Danfoss MCX programmable controller for maximum flexibility and the Danfoss EKE superheat controller with temperature and pressure sensors to fine tune any chiller's output to your desired specifications.



System Protectors

When your customers purchase one of your chillers, they want to know that their investment is secure. Our line of driers, check valves, ball valves, and other system protectors are designed to perform under the most strenuous operating conditions and protect your equipment from potential failures.

Danfoss system protectors have been thoroughly tested in our labs & in the field in order to guarantee trouble-free operation during your system's lifetime.

Valves

Choosing the right valve for your system ensures you get the optimal superheat flow just right, meaning your chiller will ensure the desired comfort and cool it's supposed to. Danfoss has a wide assortment of valves, giving you the ability to choose the right one for your system's need.

From our TGE valve to the ETS Colibri line, Danfoss has extensive experience in thermostatic and electric valves with proven track records of performance, quality, and durability.





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Application Development Centers to optimize your chiller designs*

Danfoss Application Development Centers

For Danfoss, designing environmentally conscious products and working towards a more sustainable use of resources are key issues we address through innovation, research, and teamwork.

To drive progress in this area, we've invested in building Application Development Centers (ADC) all over the globe. Because of our worldwide presence, our engineers are keenly aware of industry trends on both a global and local level. However, another benefit of the ADC is that we get to work hand-in-hand with our customers to find new solutions.

When we work together to combine your expert knowledge of chiller systems with our deep understanding of components, we're able to push the envelope of what can be achieved, resulting in better chiller technology.



* Danfoss ADCs are today located in:
China - Haiyan and Wuqing, Denmark - Nordborg,
India - Oragadam, USA - Baltimore and Tallahassee

Range overview For Air and Water-Cooled chillers

| Conditions: Cooling capacities in Tons @ AHRI 60Hz, in kW @ EN12900 | Cooling capacity in TR | | | Cooling capacity in kW | | | |
|---|--|-------|------|-------------------------------|--------|-------|-------------------------------|
| | Refrigerant | Min | Max | Manifold (in TR / circuit) | Min | Max | Manifold (in kW / circuit) |
| Compression | | | | | | | |
| Scrolls | R410A | 2.4 | 40 | 120 | 6.3 | 103.4 | 303 |
| Scrolls with IDVs | R410A | 7.5 | 40 | 120 | 20 | 103.4 | 303 |
| Inverter Scrolls (Full Speed/Min Speed) | R410A | 4/1.2 | 26 | 50 | 13/4.2 | 83 | 180 |
| Turbocor® oil-free Compressors | R134a, R513A, R1234ze | 60 | 400 | 1 000+ | 200 | 1 200 | 3 000+ |
| Condenser | | | | | | | |
| MCHE | R410A/R134a | 1 | 40 | no limit | 3.5 | 105 | no limit |
| MPHE Condensor* | R410A | 1 | 170 | - | 3.5 | 400 | - |
| Evaporator | | | | | | | |
| MPHE Evaporator | R410A | 1 | 170 | - | 3.5 | 400 | - |
| Level Sensor AKS | | | | | | | |
| Economizer | Available upon request | | | | | | |
| Expansion devices | | | | | | | |
| Thermostatic Expansion Valve TGE | R410A | 3.5 | 52 | | 12 | 182 | |
| | R134a | 1.5 | 29 | | 6 | 102 | |
| Electric Expansion Valve ETS C (Colibri) | R410A | 20 | 141 | | 70 | 488 | |
| | R134a | 13 | 91 | | 45 | 317 | |
| Discharge Line | | | | | | | |
| Check Valves NRV/NRVH | R410A | 0.5 | 54.6 | | 1.8 | 191 | |
| Check Valves NRV/NRVH | R134a | 0.3 | 34.4 | | 1.16 | 121 | |
| Ball Valves GBC | 1/4" to 3 1/8" connection for inline version | | | | | | |
| High Pressure Switch (Safety) ACB | High and low pressure versions | | | | | | |
| Pressure sensor AKS | Max. measuring range: 0-600 bar - Medium Temp: -40 to 85 °C (185 °F) | | | | | | |
| Temperature Sensor AKS | Temperature ranges up to 180 °C (356 °F) | | | | | | |
| Liquid Line | | | | | | | |
| Ball Valves GBC | 1/4" to 3 1/8" connection for inline version | | | | | | |
| Filter Driers DML, DCR | Drying capacity 2.4 - 134 kg | | | | | | |
| Sight Glass SGP | 1/4" to 7/8" connection for inline version. Saddle version for larger tube sizes | | | | | | |
| Solenoid Valve EVR | R410A | 0.9 | 106 | | 7 | 370 | |
| Solenoid Coil (liquid capacity - ΔP=0.15bar) | R134a | 0.85 | 100 | | 3 | 350 | |
| Suction Line | | | | | | | |
| Ball Valve GBC | 1/4" to 3 1/8" connection for inline version | | | | | | |
| Low Pressure Switch ACB | High and low pressure versions | | | | | | |
| Suction Pressure Transducer AKS 32R | High and low pressure versions | | | | | | |
| Pressure sensor AKS 32R | Max. measuring range: 0-600 bar - Medium Temp: -40 to 85 °C (185 °F) | | | | | | |
| Temperature Sensor AKS 11 | Temperature ranges up to 180 °C (356 °F) | | | | | | |
| Control Panel | | | | | | | |
| System Controller MCX | 8 Models of Programmable Controllers - Inputs/Outputs (AI/DI/AO/DO): from 4/6/2/6 to 16/22/6/20 | | | | | | |
| EKE 1 Superheat Controller | Drives all Danfoss stepper valves. MSS, LoadApp, fixed superheat control. Models with Modbus, Canbus. Wide sensor selection. Driver function with bus or analog-in input. | | | | | | |
| Power supply AK-PS | Power Supply 24V DC 0.75 / 1.5 / 2.5 Amps | | | | | | |
| VLT HVAC & VLT Refrigeration Drive | Supply Voltage Range: 200-690V, Power Range: 1.1-1400kW | | | | | | |
| CDS Drive for VZH | Supply Voltage Range: 200-600V, Power Range: 6-30kW | | | | | | |
| VACON NXC Low Harmonic AFE Drive | Supply Voltage Range: 380-690V, Power Range: 0.55- 2000 kW | | | | | | |
| VACON 3000 Medium Voltage Drive | Supply Voltage Range 3300V 2430-7030kVA/4160V 2450-7060kVA | | | | | | |

* Applicable in Water-Cooled chillers only

For more information about refrigerant qualification programs and product selection, please contact Danfoss and refer to Coolselector



Let's talk

At Danfoss, we believe that long-term business relationships start with a conversation.

- To understand your situation
- To learn how we can meet your needs
- To give you confidence in our solutions

So contact your local Danfoss representative – **and let's talk.**



Access our **online services 24/7**

You can find many helpful resources on our website, including product catalogues, educational and training programs, downloadable manuals and apps, and troubleshooting tools.

Danfoss online self-services

- Chillers: Chillers.danfoss.com
- Product selection: Coolselector.danfoss.com
- Learning platform: Learning.danfoss.com



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